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(19)

(54) IMPROVEMENTS IN OR RELATING TO GAS GENERATING DEVICES

(71) We, ETAT FRANCAIS, represented by the Minister of the Armed Forces, the Ministerial Delegation for Armaments, of 14 rue Saint Dominique, 75997 Paris Armees, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a device for generating gas by reaction of a liquid with a solid or another liquid.

It is frequently desired to produce gas in a chamber to allow the chamber to rise through its surrounding medium. The chamber need not be inflatable. Vessels which it may be desirable to fill with gas include submarine ballast tanks, submerged buoys and balloons.

The procedure commonly employed to empty the ballast tanks of submarines involves blowing off the water contained in the said tanks by a gas which is compressed to a pressure higher than the hydrostatic pressure obtaining at a particular depth. This compressed gas is generally supplied by vessels filled with a compressed gas at a pressure higher than that which is required. Such vessels are, however, heavy and cumbersome.

An alternative way of producing gas for the aforesaid purposes has been to effect a reaction between liquid or solid materials which themselves occupy a small volume. Hot gas generators using propellants have already been employed for this purpose. However, these generators require the use of an envelope or casing for the propellants which is resistant to ambient pressure thereabout when the generators are used under the sea, and to the high internal pressure which is produced therein when combustion of the propellant has taken place. Furthermore, the hot gas produced by the combustion of the propellant is propellant-type generators may be a problem, particularly with respect of damage to certain types of equipment or materials which are temperature-sensitive, for example, certain joints made of rubber or of other elastomeric materials.

According to one aspect of the present invention, there is provided a gas-generating device intended for use inside a vessel, the device comprising a fluid-tight and deformable envelope containing a solid material capable of producing a body of a gas when contacted with a liquid reactive therewith, a liquid which does not react with said solid material or the liquid reactive therewith and means for splitting open the envelope, in use, to place the contents of the envelope in contact with a said reactive liquid said envelope splitting means comprising an explosive charge and means for remotely controlled detonation of said charge.

According to a second aspect of the present invention, there is provided a gas-generating device intended for use inside a vessel, the device comprising a fluid-tight and deformable envelope containing a liquid material capable of producing a body of a gas when contacted with a liquid reactive therewith and means for splitting open the envelope, in use, to place the liquid in the envelope in contact with said liquid reactive therewith, said envelope splitting means comprising an explosive charge and means for remotely controlled detonation of said charge.

The envelope which contains the gas-generating material is filled with a liquid. This can be a liquid material capable of producing a body of gas when contacted with another liquid or, when the envelope contains a solid material capable of reaction with a liquid to produce a body of gas, a liquid which reacts with neither of the gas producing materials. When the gas-producing reactant in the envelope is a liquid the envelope can nevertheless contain an additional liquid which reacts with neither of the gas producing reactants. The liquid which reacts with neither of the gas-producing reactants is preferably a mineral oil.

The gas-generating substance is

preferably calcium hydride or lithium hydride, which react with water to liberate hydrogen. In this case, the liquid filling the envelope is, for example, paraffin oil, which does not react with calcium or lithium hydrides.

A gas-generating device of this invention can be very light and of small size. In practice, the ratio between the weight and between the volume of the solid or liquid materials, on the one hand, and the volume of the gases obtained, on the other hand, is very low and the weight of and volume occupied by these devices are negligible. Thus, 0.6 litre of solid hydride releases 1000 litres of gas at atmospheric pressure.

A gas-generating device embodying this invention is able to function under very high pressures, amounting to several hundred bars, as might be experienced at submarine depths of several thousand metres. In practice, the flexible envelope takes up and transmits the hydrostatic pressures to which it is subject. Hence, it is not subject to any stressing and is able to withstand very strong pressures. The presence of a liquid such as paraffin oil in the envelope serves to improve the transmission of hydrostatic pressures and to aid in preventing the envelope from being torn.

The bursting of the envelope to achieve the initiation of the gas discharge is effected by remotely controlled firing of an explosive charge using one of the many forms of ignition arrangements which have been described hitherto. The explosive charge can thus be fired by electrical, electromagnetic or acoustic signals. The discharge of gas takes place very quickly as soon as the reactant in the envelope, for example, a hydride, is brought into contact with a liquid reactive therewith which is water when the envelope contains a hydride, and this permits a desired operation to be initiated with minimal delay.

A gas discharge device according to this invention containing a hydride can be employed for the inflation of weather balloons, because of its lightness and because it releases hydrogen, which is lighter than air.

Gas discharge devices according to this invention of small volume can be produced relatively inexpensively, which enables them to be used in applications which do not always necessitate large gas volumes, for example, for inflating buoys, or reinflatable buoyancy chambers or weather balloons.

For a better understanding of the invention and to show how the same can be carried into effect reference will now be made, by way of example only, to the accompanying drawings, in which:—

Figure 1 is a section through a device according to the present invention, placed in a water-filled vessel, and

Figure 2 is a section through a device according to this invention which is attached to an inflatable balloon.

Referring to Figure 1, there is shown a water-filled chamber 1, which, in practice, can be a submarine ballast tank, a buoy, a tank or a diving bell. The base of this chamber is provided with a plurality of openings 6 owing to its being constituted by a grid 7 through which the chamber communicates with the medium surrounding it when it is submerged as shown.

Arranged in the chamber 1 is a gas-generating device. This device is designed to produce in the chamber 1, at a desired moment, a quantity of gas which will form a gas pocket in the upper part of the chamber 1 and thus will modify the buoyancy of the chamber 1. To enable the construction of this device to be understood, the device has been drawn to an enlarged scale in relation to the size of the chamber 1.

The gas-producing device is constituted by a fluid-tight, flexible and burstable envelope 2 containing a solid material 3, for example, calcium or lithium hydride, which can react with the medium surrounding the chamber 1 to produce gas. The solid material is dispersed in a body 4 of paraffin oil which fills the envelope 2. It is pointed out that it is also possible to use a liquid which reacts with the medium in and around the chamber 1 to produce a gas. The envelope 2 also contains an explosive charge 5 having ignition means (not shown) which can be operated by remote control.

Operations of the arrangement of Figure 1 is as follows. When it is desired to blow off the water from the chamber 1, for example, to enable a submarine to surface, detonation of the charge 5 is initiated from a distance by remote control and this causes the envelope 2 to burst open. The hydride particles are then brought into contact with water and immediately there is generated a considerable amount of gas. The gas forms a bubble in the upper part of the chamber 1. The hydride grains are held in the chamber 1 by the grid 7 so that their gas-generating capacity is utilized to the maximum extent possible.

Referring to Figure 2, a gas-generating device is attached to an immersed inflatable balloon 8, for example, a balloon used for refloating a submerged body. The gas-generating device serves to inflate the balloon 8, at a predetermined moment, and is operated by remote control.

The gas-generating device comprises a reaction chamber 9, the lower part of which is provided with a plurality of openings 10 communicating with an aqueous medium surrounding the balloon and the upper part of which is provided with openings 11 for

through passage of gas generated into the interior of the balloon 8. The chamber 9 is filled with water and contains an envelope 13 which is closed in fluid-tight manner at its opposite ends by membranes 14*a* and 14*b* which can easily be burst. The envelope 13 is filled with paraffin oil 15, in which are immersed calcium hydride or lithium hydride particles 16 and explosive charges 17*a* and 17*b*, provided with a device for ignition thereof from a distance, for example by acoustic waves generated at a position remote from the charges.

Although the gas producing device shown in Figure 2 serves to inflate a submarine balloon, in which case the gas produced must have a pressure greater than the hydrostatic pressure of the surrounding water, it is pointed out that such a device could also be used for inflating atmospheric balloons or buoys.

In summary, thus a gas-generating device according to this invention can be used for blowing the water in the ballast tanks of a submarine and in tanks, buoys and diving bells, in general, and also for inflating submarine refloatable vessels or atmospheric, for example weather, balloons.

WHAT WE CLAIM IS:—

1. A gas-generating device intended for use inside a vessel, the device comprising a fluid-tight and deformable envelope containing a solid material capable of producing a body of a gas when contacted with a liquid reactive therewith, a liquid which does not react with said solid material or the liquid reactive therewith and means for splitting open the envelope, in use, to place the contents of the envelope in contact with a said reactive liquid, said envelope splitting means comprising an explosive charge and means for remotely controlled detonation of said charge.

2. A gas-generating device intended for use inside a vessel, the device comprising a fluid-tight and deformable envelope containing a liquid material capable of producing a body of a gas when contacted with a liquid reactive therewith and means for splitting open the envelope, in use, to place the liquid in the envelope in contact with a said liquid reactive therewith, said envelope splitting means comprising an explosive charge and means for remotely controlled detonation of said charge.

3. A gas-generating device as claimed in Claim 2, in which the envelope additionally contains a liquid incapable of reacting with either said liquid material within the envelope or the liquid capable of reacting with said liquid material.

4. A gas-generating device as claimed in Claim 3, in which the liquid within the envelope which is incapable of reacting with said liquid material is a mineral oil.

5. A device as claimed in Claim 1, in which the liquid in the envelope is a mineral oil.

6. A device as claimed in Claim 1, in which the envelope contains a hydride which reacts with water to produce hydrogen.

7. A device as claimed in Claim 6, in which the hydride is lithium hydride or calcium hydride.

8. A device as claimed in any one of the preceding claims, in which said envelope is constituted by a closed bag formed of a flexible material.

9. A device as claimed in any one of the preceding claims, which is housed in a chamber provided in a lower part thereof with a number of openings and in its upper part with openings for passage of gas.

10. A device as claimed in Claim 9, in which the openings in the upper part of the chamber communicate with the interior of an inflatable balloon or bag.

11. A device as claimed in Claim 10, in which said openings communicate with the interior of a buoy, a balloon for refloating a submarine vessel or a balloon for use in the atmosphere.

12. A device as claimed in any one of Claims 1 to 8, which is installed in a ballast tank of a submarine or a diving bell.

13. A gas-generating device substantially as hereinbefore described with reference to, and as shown in, Figure 1 or Figure 2 of the accompanying drawing.

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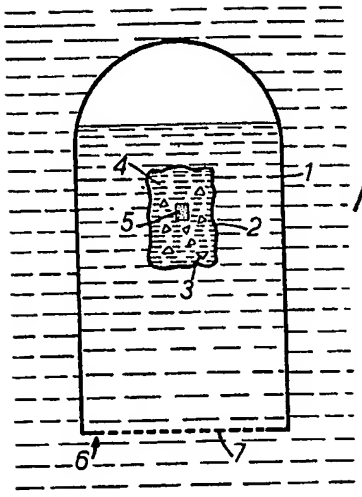

FIG. 1.

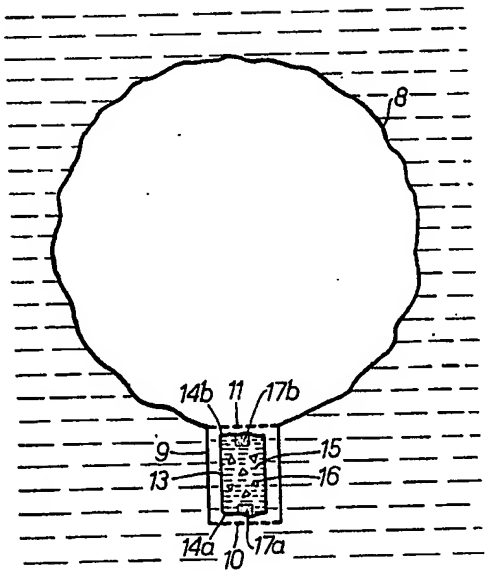

FIG. 2.